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Linguistic Models 20

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Contents

Introduction

Wang Jialing and Norval Smith

0. Introduction

The present volume contains nine papers on the phonology of Chinese. Chinese is the language spoken by the Han nationality, the largest of the 56 nationalities in China. The Han nationality comprises about 95 per cent of the entire population of more than 1.1 billion people. Chinese consists of a number of dialects, which can be classified into five major "dialects": Mandarin, Wu, Min, Yue and Hakka (Wang Li 1985). The largest is Mandarin, which is spoken by around 75 per cent of the Chinese-speaking people. It is spoken north of the Yangzi River and in the southwest. The four non-Mandarin dialects are all spoken along the southeast coast: Wu in Shanghai and the neighboring province of Zhejiang and southern Jiangsu; Min in Fujian province and on the islands of Taiwan and Hainan; Yue in the province of Guangdong and part of Guangxi; and Hakka in the northeastern part of Guangdong, western Fujian and southern Jiangxi.

Taking mutual intelligibility as a criterion for the distinction between language and dialect, the five dialects have been regarded as different languages by some linguists as they are in fact mutually unintelligible. Other linguists, however, take them as dialects within one and the same language, Chinese. The claim is that mutual intelligibility should not be the sole defining criterion. Lyu (1988) maintains that there should be the additional criterion of whether there is a commonly recognized standard language and a unified writing system. Since Chinese has had a commonly recognized standard and a unified writing system throughout its history, the five dialects could by this criterion be considered dialects of a single language.

1. Tone and syllable structure

1.1. Synchrony

A prominent characteristic of Chinese phonology is its lexical tone. Each syllable has a lexically specified tone which can distinguish lexical meaning. For example, there are four tones in Putonghua (Standard Mandarin). When applied to the same syllable, four different lexical items may result. The classic example is the following.

(1)

syllable	tone	gloss
ma	high level	'mother'
ma	high rise	'hemp'
ma	fall-rise	'horse'
ma	falling	'scold'

The five dialects differ in the size of their tonal inventories, as shown in (2).

(2)

Mandarin	3 - 5 tones (usually 4)
Hakka	6 tones
Wu	7 - 8 tones (Shanghai has only 5)
Min	7 - 8
Yue	8 - 10

When two or more tones occur in sequence, there are sometimes changes in one or more of the tones. This is called *tone sandhi*. Different dialects have different types of tone sandhi, as is exemplified in the several papers on tone sandhi in this volume. Even among the sub-dialects of a given major dialect, there are different pitch values for the tones and different kinds of sandhi phenomena. For instance, Putonghua and Tianjin are both sub-dialects of Mandarin, and both have four tones, but the pitch values of their four tones are different and they behave differently in terms of tone sandhi (cf. Wang, this volume, Milliken et al., this volume).

A second characteristic of Chinese is that it has a very simple syllable structure. For example, the maximal syllable structure for Mandarin is CGVC while for Cantonese (a sub-dialect of Yue) it is CVC (cf. Yip, this volume).

Notwithstanding this common characteristic, the five dialects are different in terms of the voicing of stops when they appear as onsets and also in terms of the admissibility of stops as codas. For instance, Wu has unaspirated voiced stops as onsets while the other dialects do not. Yue, Hakka and Southern Min admit *-p*, *-t* and *-k* as codas, Wu admits the glottal stop *-ʔ*, while Mandarin and Northern Min do not admit any stop as coda.

1.2. Diachrony

The common properties and differences of the dialects are due to the fact that, with perhaps the exception of Min, they are all descended from a common ancestor - Middle Chinese (c.600 A.D.) - but underwent different diachronic processes subsequently. For instance, voiced obstruent stops in Middle Chinese developed along different lines in the five dialects, as shown in (3).

(3) Development of Middle Chinese voiced stop onsets

Mandarin:	voiceless stops (aspirated for syllables with "even" tone, and unaspirated for syllables with "oblique" tones)
Yue:	same as Mandarin
Wu:	voiced unaspirated stops
Hakka:	voiced aspirated stops
(Min:	voiceless unaspirated stops)

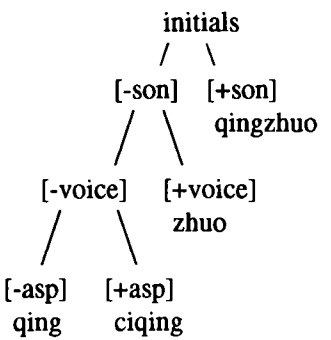
Even tone refers to the "ping" tone, and *oblique* tones refer to the other three tones in Middle Chinese. An account of Middle Chinese tones will be given later. Much valuable data has been preserved in the rhyming dictionaries and rhyme tables compiled at different periods of Chinese history. These serve as the basis for reconstructing the phonological systems and phonetic values of the Chinese of various periods. Rhyming dictionaries are lexicons in which Chinese characters were grouped together according to their rhyme (vowel + coda) and tone. These dictionaries gave the correct pronunciation of the characters and served as guidebooks for scholars in writing poetry. The compilation of rhyming dictionaries was made possible by the invention of *fanqie*, and the recognition of tones in Chinese. *Fanqie* (literally 'reverse cut') is a way of transcribing the pronunciation of a Chinese character by using two characters, the first indicating the initial (onset), and the second indicating the rhyme. To take an example, the character *tong* is transcribed as *tu hong fan* or *tu hong qie* (*fan* or *qie* being used to indicate that the *fanqie* method of transcription is used). This would mean that the pronunciation of *tong* is obtained by putting together the initial of the first character *tu*, and the rhyme and tone of the second character *hong*. The earliest known use of *fanqie* dates from the end of the Eastern Han Dynasty (c.200 A.D.). Tone, however, was not yet taken into account at that time.

The importance of tone was first recognized by Shen Yue (441-513 A.D.). He regarded Chinese as having four tones, "ping" (level), "shang" (ascending), "qu" (departing) and "ru" (entering). These were used in the rhyming dictionary he compiled to classify rhymes.

Of the many rhyming dictionaries complied over the centuries, the most influential has been the *Qie Yun* compiled by Lu Fayan in 601 A.D. (Sui Dynasty). Although the complete book no longer exists, its preface and its system are preserved in the *Guang Yun*, a rhyming dictionary compiled by Chen Pengnian and others in 1008 A.D.(Song Dynasty). Being based on the *Qie Yun*, the phonological system inherent in the *Guang Yun* can be taken as that of the *Qie Yun*. This dictionary is composed of five volumes, the first two volumes containing characters involving the Ping tone, and the other three volumes containing characters involving the other three tones. The *Qie Yun* had 193 rhymes, which were expanded to 206 in the *Guang Yun*. Since Chinese is not written in letters which can spell out the pronunciation, it is difficult however to determine the exact pronunciation through the *fanqie* transcriptions.

To help people get the correct pronunciation, rhyme tables were developed. Rhyme tables are actually syllabaries, with vertical columns used to indicate initials, and horizontal rows used for rhymes. The intersection gives a character whose pronunciation is made up of the given initial and rhyme. The earliest rhyme table is the *Yun Jing* (Rhyme Mirror). It used 43 tables to cover all the syllables. Each table has 23 vertical columns which are grouped into seven categories, grouped basically according to their place of articulation. These categories are subdivided into four sub-categories according to the status of voicing, aspiration and sonority. The four sub-categories, "qing" (clear), "ciqing" (second clear), "zhuo" (turbid) and "qingzhuo" (clear-turbid), can be represented in terms of the three modern features [sonorant], [voice] and [aspiration] as in (4).

(4)



The "qingzhuo" class represents sonorants, the "zhuo" class represents voiced obstruents, the "ciqing" class represents voiceless aspirated obstruents, and the "qing" class voiceless unaspirated obstruents.

Later rhyme tables also use the thirty-six so-called *Shouwen* initial characters in the vertical columns to represent initials. (These are named after the Tang dynasty monk Shouwen who is said to have used this method of representation first). Each table is horizontally divided into four parts, each part containing a character with a given rhyme but with a different tone. (Rhymes with the entering tone have stops as coda corresponding to the nasal codas in the other three tones.) Each part is again sub-divided into four *deng* (rank). The ranks are classified gradiently according to the backness and height of the nucleus vowel in the rhyme, the vowel in rank 1 rhyme being the lowest and most back. Rank 3 and 4 rhymes have the glide *y* before the vowel while ranks 1 and 2 do not. Rhymes are also classifed according to whether they have the glide *w* before the vowel. Rhymes with the glide *w* serving as medial are called "open-mouth" rhymes, while those lacking this are called "closed-mouth" rhymes. Open- and closed-mouth rhymes are placed in different tables. Later rhyme tables grouped the 206 rhymes into 16 *she* (rhyme groups), and these groups are further classified as "outer" rhymes and "inner" rhymes, the exact meaning of the terms "outer" and "inner" being still a matter of controversy.

The meticulous classification of the rhyme tables went far beyond the needs of rhyming for poetry writing, and now constitutes useful material for the reconstruction of the historical phonological system. Using the rhyming dictionaries and rhyming tables together with the different dialects of the present-day, it is possible to reconstruct the phonological systems and phonetic values of Chinese at different periods. The first scholar to do so was the Swedish linguist Karlgren (1915-1926), and following him much additional work took place. Wang Li (1985), for example, reconstructed the sound systems of Chinese for nine historical periods. The appendix in Pulleyblank (this volume) shows his reconstruction of the phonological system of Late Middle Chinese.

As noted above, the *Qie Yun* is regarded as the most influential of the rhyming dictionaries. This is because of a general assumption that all present-day Chinese dialects (with the possible exception of Min) are descended from the *Qie Yun* phonological system, also called Middle Chinese. There is controversy whether that system represents a single dialect of that period, or whether it is an artificial system which combines aspects of different states of diachronically distinct systems. The consensus nevertheless is that it is a consistent and authoritative system, and very useful in understanding the development and structure of present-day Chinese dialect sound systems.

Take the question of tones for instance. Different dialects have different numbers of tones, but if we follow the assumption that the four tones in Middle Chinese, "ping", "shang", "qu" and "ru", split with the passage of time into two categories "yin" and "yang" (referred to as "high" and "low" register in Chen and Zhang (this volume), the confused state of affairs starts to clear up. Syllables with voiceless initials tend to have higher pitch than their voiced-initial counterparts, and so each tonal category split into two according to the voicing of the initials. This is exemplified by the Wu dialects, for example Shanghai (cf. Jin, this volume) and Chongming (cf. Chen and Zhang, this volume). The other dialects subsequently lost the distinction between voiced and voiceless consonants, but the lexical contrasts were preserved in the tonal differences. This accounts for the nine tones in Cantonese, for example. In Mandarin the "ping" tone divided into two tones "yinping" and "yangping". The "ru" tone no longer exists because of the loss of the stop codas, and the syllables originally bearing this tone merged into the other three tones. Thus most Mandarin dialects have four tones: "yinping", "yangping", "shang", and "qu".

One unsolved problem is why the pitch values for the same tonal category are so different for the different dialects and sub-dialects. For instance, "yinping" is high and level in Putonghua, while it is low and level in Tianjin. Milliken et al. (this volume), have however posited a floating high tone for "yinping" in Tianjin based on tone sandhi facts. The source of this high floating tone may find its explanation in the origin of "yinping", which came from syllables with voiceless initials and originally had high pitch.

2. Theoretical approaches to syllable structure

2.1. The theoretical relevance of Classical Chinese approaches to the syllable

While the analysis of the internal structure of the syllable is still a matter of some controversy, it is clear that early Chinese phonologists - and they certainly deserve this label - had carried out an analysis in terms of syllable structure, with which Western phonologists would only catch up some 17 centuries later. The concept of *fanqie* corresponds exactly to the analysis of syllables into *onset* and *rhyme*.

We have mentioned the major rhyming dictionary *Qie Yun* (601 A.D.) and its division into 5 volumes concerned with the four tones. The first two volumes contain 54 rhymes in the "ping" tone; Volume 3 contains 51 rhymes in the "shang" tone; Volume 4 56 rhymes in the "qu" tone; and Volume 5 32 rhymes in the "ru" tone. This seems to indicate that the compiler Lu Fayan did not regard tone as a feature of the rhyme but rather as an aspect of the syllable, which could be utilized to organize the different (segmental) rhymes.

In each tonal category of the *Qie Yun*, the rhymes are arranged in the same way. "Ru" tone rhymes, which all end with stop consonants, are arranged in the same order as the corresponding rhymes with nasal endings in the other three tonal categories. We can assume from this that an analysis of the rhyme into *nucleus* and *coda* had effectively been performed by the time of the Sui dynasty.

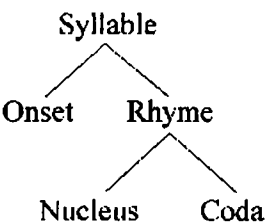


Figure 1. Early Chinese syllable analysis

Subsequently the rhyme was divided into three components, respectively *yun-tou* (rhyme head), *yun-fu* (rhyme belly), and *yun-wei* (rhyme tail). *Yun-tou*, also termed *medial*, refers to the optional pre-vocalic glide; *yun-fu* refers to the vowel peak; and *yun-wei* refers to the coda. The concepts underlying this analysis are about a thousand years old.

In other words, three, increasingly detailed, analyses can be distinguished.

(5) a. 200 A.D. Onset Rhyme
b. 600 A.D. Onset Rhyme[Nucleus + Coda] Tone
c. 1000 A.D. Onset Rhyme[Medial + Nucleus + Coda] Tone

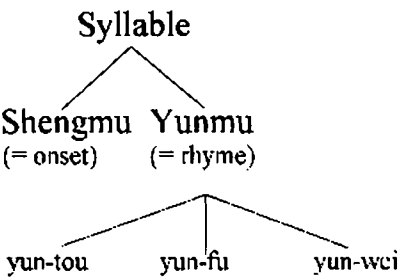


Figure 2. Chinese traditional syllable analysis

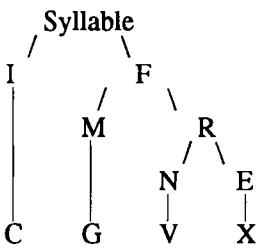
2.2. Modern approaches to Chinese syllable structure

Modern Chinese linguists have proposed various structures for the Putonghua syllable. Xu (1980), Lin & Wang (1992), and others, retain essentially the traditional analysis for the segmental aspects of the syllable:

(6) Onset Rhyme[Medial + Nucleus + Coda]

Others, of whom Lin (1989) is a recent example, identify the same constituents, but assign to the rhyme a hierarchical internal structure rather than a flat structure.

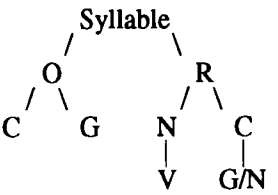
(7)



I = initial (onset) F = final M = medial
R = rhyme N = nucleus E = ending (coda)
C = consonant G = glide V = vowel
X = glide, nasal

Yin (1989), among others, adopts an alternative view concerning the *G* constituent, i.e. the glide that optionally occurs following an initial consonant, and preceding the vowel. She considers this to be part of the onset, as follows:

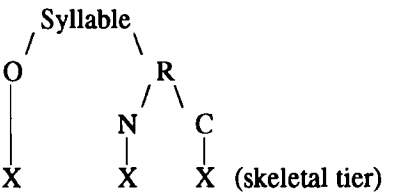
(8)



O = onset C = consonant
R = rhyme G = glide
N = nucleus V = vowel
C = coda N = nasal

Duanmu (1990) adopts a three-slot approach, which he claims is applicable to all Chinese dialects.

(9)



3. Approaches to Tone

A standard approach to tone, prior to autosegmental phonology, is that it represents a feature of vowels or other sonorants. This is represented in its most extreme form by Halle & Stevens (1971), who take the view that tone is to be interpreted in terms of the same laryngeal features that are used to express the various phonation types in consonants: [constricted glottis], [spread glottis]. These are not otherwise distinctively necessary for the expression of vowels, which are phonologically all of the same type, i.e, voiced, unaspirated, and nonglottalized. In this view then tones are just features of vowels, and other sonorants, and completely integrated into the system of segmental features.

Other less tightly integrated accounts involve special tone features associated with the segments that bear tone, but indistinguishable from the *segmental* features in the way they are associated to segments. In all such approaches tone is clearly *part* of the segments occurring in the rhyme.

The *Qie Yun* approach diverges from this. In *Qie Yun* and other rhyming dictionaries, tone is treated on a par with the onset and rhyme, which is clearly

not in agreement with the "tone-as-vowel-feature" approach. This idea found its latest expression in the autosegmental theory, which also does not treat tone as feature of the vowel, but regards it as a suprasegmental property, representing it by tonal features on one or more separate tiers. All the papers concerning tone in the present volume make use of the autosegmental theory to analyse Chinese tones. It is interesting to note that Chinese tones were treated using essentially the same basic idea in the compilation of *Qie Yun* nearly 1400 years ago.

4. The contents

The nine papers in this volume are devoted to two topics - tone systems and segment systems.

4.1. The tone system

Chen and Zhang's article on "Lexical and postlexical tone sandhi in Chongming" is an extremely thorough analysis of tone sandhi phenomena in a dialect spoken north of Shanghai. They show that (lexical) compounds are subject to lexical tone sandhi, and clitic groups to postlexical tone sandhi, while phrasal structures are not a domain for sandhi phenomena. Among clitic groups are to be counted besides the typical word-pronoun structures encountered in other languages, other structures such as verb + resultative complement structures which would not typically form clitic groups in most languages.

The article by Milliken, Zhang, Zhang, Li and Lü, "Resolving the paradox of Tianjin tone sandhi", lays the main emphasis in searching for an explanation to this paradox not so much on rules, as on the interaction of (underspecified) lexical representations with general principles such as the OCP.

Shih's article "Mandarin third tone sandhi and prosodic structure" reveals evidence for the hierarchical nature of prosodic structure. The main domains for the important process of third tone sandhi are the disyllabic foot (obligatory) and the intonation phrase (optional).

The article by Jin "Toward a Systematic Account of Shanghai Tonal Phonology" is basically also concerned with sandhi phenomena. Here however the tone of the first syllable of a compound - no matter how long - determines the final tone pattern of the whole compound. Interestingly enough both moras and syllables are relevant, leading Jin to claim that Shanghai is both mora-counting and syllable-counting.

Wang's article "The representation of the neutral tone in Chinese Putonghua" demonstrates that the facts concerning the realization of the neutral tone in Standard Mandarin have only been inadequately dealt with up till now. Previous analyses have not dealt with the full range of data involved, and have assumed that the

tone is fully determined by the preceding syllable. Wang adopts a zero-representation for the neutral tone. This, together with a combination of universal default rules and language-specific rules produces the desired result.

4.2. The segment system

Pulleyblank provides a new analysis of the Cantonese vowel system in his article "The Cantonese Vowel System in Historical Perspective". Cantonese has proved a thorny problem in the past because of the lack of synchronic morphophonemic alternations. What is new in Pulleyblank's careful analysis is that he makes use of diachronic developments as a source of evidence for the synchronic state of affairs.

Underspecification plays a major role in Wiese's article "Underspecification and the description of Chinese vowels". He analyses the Standard Mandarin vowel system with the help of principles including radical underspecification and the obligatory contour principle. With the help of some well-motivated allophonic rules in addition, the whole vowel system can be satisfactorily derived.

In her article "Consonant-Vowel Interaction in Cantonese", Yip studies the question of planar V/C segregation with respect to Cantonese. This problem is of interest because of the virtual morpheme=syllable constraint holding in Cantonese. Because of this no ordering relationships between segments require to be defined in the lexicon. However, there are certain interactions between adjacent C's and V's. These cannot be stated in terms of underlying forms, but can be defiened at a later stage in the derivation.

Chan studies the problems involved in establishing the correct representation(s) of the glottal stop in the Fuzhou dialect in her article "Fuzhou glottal stop: Floating segment or correlation of close contact?". The glottal stop appears in two varieties - one alternating with zero, and one stable. A solution in terms of syllable structure is argued for whereby the alternating ("disappearing") glottal stop forms part of the nucleus, while the stable glottal stop is in the coda.

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Lexical and postlexical tone sandhi in Chongming

Matthew Y. Chen and Hongming Zhang

0. Introduction

Chongming is a northern Wu dialect, spoken by some 700,000 inhabitants on the island of the same name located in the Yangzi delta, north of Shanghai city. The corpus of our analysis consists of two published reports (H.-Y. Zhang 1979, 1980), and data we collected in the spring of 1988 from the author of the aforesaid reports.[1]

Although Chongming tone sandhi is both complex and interesting from the phonological point of view, our primary focus here is on the morphosyntactic factors that delimit and condition the operation of tone sandhi both at lexical and postlexical levels. As we shall see, the facts about Chongming tone sandhi pose interesting and fundamental questions about such issues as the accessibility of morphosyntactic information to the operation of phonological rules, the lexical cycle, and the criteria for distinguishing lexical compounds (syntactic words) from clitic groups (phonological words) and syntactic phrases. We shall first provide some background information concerning the tone system of Chongming. Then in sections 1 and 2 we shall deal in turn with lexical and postlexical tone sandhi processes. In section 3 we shall turn to the question regarding the diagnostic tests for "wordhood" and the definition of phonological words. General discussion highlighting our principal findings follows in section 4.

The four Middle Chinese (c. 6th century A.D.) tones have evolved into a symmetrical eight-tone system in Chongming, neatly partitioned into two registers corresponding to the voicing contrast of the initial consonants, as shown in Table 1.

Table 1. Chongming tone system

Middle Chinese categories		"ping"	"shang"	"qu"	"ru"
		"even"	"oblique"		"even"
Chongming tones	High register	1 H	3 HMH	5 M	7 H?
	Low register	2 LM	4 LML	6 MLM	8 L?

Given the uncertain nature of the exact phonetic values of the Middle Chinese tonal categories, we follow the custom of referring to them by their traditional nomenclature: *ping, shang, qu* and *ru*, which translate roughly as "level", "ascending", "departing" and "entering tones", respectively. The Chongming tones are numbered sequentially from 1 to 8, with their pitch contours indicated by a combination of H, M, L (high, mid, low). The symbol *?* stands for a glottal stop, a Chongming residue reflecting the Middle Chinese stop endings [p, t, k]. As will become obvious from our account to follow, Chongming tone sandhi behavior cannot be described without constant reference to the dichotomy between "even" and "oblique" tones (abbreviated in the tables as E and O respectively). Synchronic data strongly suggest that the original even/oblique distinction must have been rooted in the relative complexity of the tonal structure: oblique tones tend to exhibit complex pitch movements (HMH, LML and MLM), while even tones appear to represent for the most part steady-state pitches (H, H?, L?). This otherwise clearly phonetically based partition must have been obscured by intervening historical changes: thus the dynamic tone 2 [LM] is classified as even, while the level tone 5 [M] behaves like an oblique tone.[2]

1. Lexical tone sandhi

1.1. Disyllabic lexical tone sandhi

One of the pervasive features shared by all Wu dialects that we have examined is the distinction between lexical and postlexical tone sandhi (LTS and PTS, respectively, for short).[3] Generally speaking, the former operates within lexical compounds or syntactic words (s-words), while the latter affects larger units such as clitic groups or phonological words (p-words). Tone sandhi (TS) is generally blocked in truly phrasal constructions. For expository expediency, we shall rely for the moment on some intuitive notion of wordhood and postpone a fuller

discussion of the diagnostic tests used to separate lexical compounds from syntactic phrases until section 3.

Table 2 summarizes the correspondences between the base tones and their sandhi forms generated by lexical tone sandhi (LTS) applying to a disyllabic compound.

Table 2. Disyllabic lexical tone sandhi

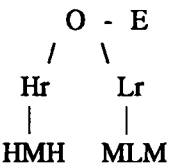
<table>
<tr><td colspan="3" rowspan="2">2nd syl</td><td colspan="4">Even (E)</td><td colspan="4">Oblique (O)</td></tr>
<tr><td>1
H</td><td>2
LM</td><td>7
H?</td><td>8
L?</td><td>3
HMH</td><td>4
LML</td><td>5
M</td><td>6
MLM</td></tr>
<tr><td rowspan="4">E</td><td colspan="2">1 H</td><td colspan="4" rowspan="4">$-H</td><td colspan="4">$-n</td></tr>
<tr><td colspan="2">2 LM</td><td colspan="4" rowspan="3">$-M</td></tr>
<tr><td colspan="2">7 H?</td></tr>
<tr><td colspan="2">8 L?</td></tr>
<tr><td rowspan="4">O</td><td rowspan="2">Hr</td><td>3 HMH</td><td colspan="4" rowspan="2">HMH-H</td></tr>
<tr><td>5 M</td><td colspan="4" rowspan="2">$-n</td></tr>
<tr><td rowspan="2">Lr</td><td>4 LML</td><td colspan="4" rowspan="2">MLM-H</td></tr>
<tr><td>6 MLM</td><td colspan="4">$-M</td></tr>
</table>

Key: Hr, Lr = high register, low register
$ = base tone (unchanged)
n = neutral tone

The base tones (that is, the tones appearing in isolation or citation forms) of the first and the second syllable of a disyllabic compound are indicated on the left column and on the top row respectively. The sandhi tones of such combinations are given in the boxes where the two base tones intersect. Thus, for instance, a sequence of /M-LM/ (or tone 5 + tone 2) shows up as [HMH-H] in lexical compounds, while /H-MLM/ (or tone 1 + tone 6) surfaces as [H-n] (unchanged base tone $ (= /H/) plus a neutral tone [n]). Some generalizations readily emerge from Table 2. Apart from the /oblique-even/ combination, the first syllable keeps its base tone unchanged in a disyllabic compound. Where the first tone does undergo change, it surfaces uniformly as a high or low fall-rise (i.e., "dipping") tone, depending on its underlying high/low register (Hr/Lr) contrast. This observation can be stated informally as lexical tone sandhi (1a).

(1) Disyllabic lexical tone sandhi

a.



b.

c.

Key: T = any tone
n = neutral tone
$ = unchanged
Hr, Lr = high/low register

Put in another way, disyllabic lexical tone sandhi (1a) maintains the register contrast, but reduces all tone melodies to a dipping (i.e., fall-rise) contour. Processes like the foregoing and many others we shall encounter presently lend support to the conception of linguistic tone as a combination of two components, namely register and melody, a traditional notion in Chinese philology that has gained wide acceptance in tonological literature since Yip (1980). Since our primary focus is not tonal feature geometry, we will not pursue this matter beyond what is immediately obvious.

Unlike the initial syllable, the second syllable undergoes change in most combinations. Thus in the second position an even surfaces everywhere as H (1b), while an oblique appears as either a neutral tone (= [n]), or a mid-level tone [M], depending on the tone shape of the preceding syllable (1c). In either case, lexical tone sandhi involves a context-free (case (b)) or context-sensitive (case (c)) neutralization of underlying contrasts in register or melody—or both. (2) illustrates how disyllabic lexical tone sandhi relates base tones to the sandhi forms.

(2) a. *tai - ping* 'peace'
M LM base tone = oblique-even
HMH H by disyllabic LTS (a,b)

b. *yu - yan* 'language'
LML LM base tone = oblique-even
MLM H by disyllabic LTS (a,b)

c. *ren - min* 'people'
LM LM base tone = even-even
LM H by disyllabic LTS (b)

d. *tian - qi* 'weather'
H M base tone = even-oblique
H n by disyllabic LTS (c)

e. *fan - zui* 'to commit a crime'
LML LML base tone = oblique-oblique
LML n by disyllabic LTS (c)

f. *zhi - nu* 'niece'
L? LML base tone = even-oblique
L? M by disyllabic LTS (c)

We adopt the following expository convention in citing examples. The first line represents the "pinyin" transliteration, followed by translation between single quotes.[4] Occasionally, when morpheme-by-morpheme gloss is called for, the gloss appears on top, above the transliteration. The second line indicates the base tones. For convenience we specify the base tone in terms of even/oblique contrasts.[5] The last line gives the sandhi output. Where appropriate, the specific rules and subcase(s) applied to generate the sandhi forms are also given.

In (2a,b) we have an oblique-even sequence, consequently disyllabic lexical tone sandhi (a) applies, producing a dipping tone in the first syllable—high in (2a) and low in (2b), depending on the Hr/Lr of the base tone. As for the second syllable, lexical tone sandhi (b) changes an underlying even into [H] in both cases, as expected. Elsewhere the sandhi tones of the final syllables ([H,M,n]) are predictable by disyllabic lexical tone sandhi clauses (b) and (c), as can be seen in (2c,d,e,f).

Lastly, all subrules of disyllabic lexical tone sandhi apply simultaneously to the base tones, otherwise subrule (c) applying after (a) would wrongly predict [M] as the sandhi tone for the second syllable in (2f)—since the first tone would have changed to [HMH], which in turn conditions the selection of [M] as the sandhi form for an underlying oblique tone.

1.2. Trisyllabic lexical tone sandhi

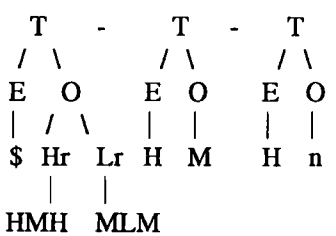
Lexical tone sandhi rules affecting longer, polysyllabic compounds are an extension of disyllabic lexical tone sandhi. This can be seen clearly in Table 3, where the first and second tones are indicated on the first and second columns on the left, while the tonal categories of the third and last syllable are given across the top.

Table 3. Trisyllabic lexical tone sandhi

1st syl		3rd syl / 2nd syl	Even (E)				Oblique (O)			
			1 M	2 LM	7 H?	8 L?	3 HMH	5 M	4 LML	6 MLM
E		E	\$-H-H				\$-H-n			
		O	\$-M-H				\$-M-n			
O	Hr	E	HMH-H-H				HMH-H-n			
		O	HMH-M-H				HMH-M-n			
	Lr	E	MLM-H-H				MLM-H-n			
		O	MLM-M-H				MLM-M-n			

Again, we see that the sandhi behavior can be predicted by reference to the "natural" classes defined in terms of Hr/Lr and even/oblique contrasts alone. In fact, the Hr/Lr contrast is relevant only for the initial syllable; elsewhere the even/oblique dichotomy alone suffices for the formulation of trisyllabic lexical tone sandhi rules given in (3).

(3) Trisyllabic lexical tone sandhi



Key: Hr/Lr = high/low register

Like disyllabic lexical tone sandhi, the subrules of trisyllabic lexical tone sandhi also apply simultaneously - that is they directly map the base tones into their corresponding sandhi forms. In fact (3) is context-free in that they predict the value of the sandhi tones solely from the underlying contrasts of even/oblique (and Hr/Lr in some cases) without regard to the preceding or following tones. As stated above, the initial tone behaves exactly as in disyllabic compounds: an initial oblique tone, changes into a high or low dipping tone depending on the underlying Hr/Lr contrast. (An initial even tone is unaffected: it retains its underlying identity). A non-initial even tone is uniformly H; while an oblique tone shows up as [M] in the second or a neutral tone [n] in the third position. Here are a few examples illustrating the effect of trisyllabic lexical tone sandhi:

(4) a. chief section-head
zheng [*zu* - *zhang*] 'the section-head'
M HMH HMH base tone = oblique-oblique-oblique
HMH M n

b. *leng* [*qi- shui*] 'cold soft-drink'
MLM M HMH base tone = oblique-oblique-oblique
MLM M n

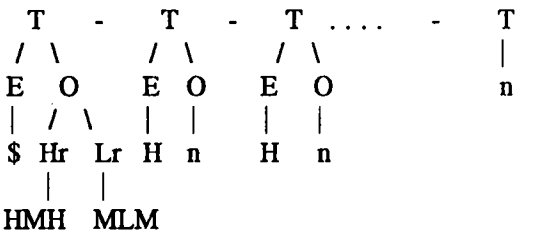
c. stop pain medicine
[*zhi* - *tong*] *yao* 'pain-killer'
HMH M L? base tone = oblique-oblique-even
HMH M H

d. trousers waist
[*ku* - *zi*] *yao* 'waist (size of trousers)'
M HMH H base tone = oblique-oblique-even
HMH M H

1.3. Polysyllabic lexical tone sandhi

Quadrisyllabic or longer compounds undergo even more drastic tonal neutralization in accordance with the following template:

(5) Polysyllabic lexical tone sandhi



(5) states that the initial syllable behaves like its counterpart in di- and tri-syllabic compounds. The final syllables always assume a neutral tone. Elsewhere, i.e., in medial positions, all evens surface as [H], whereas all obliques emerge as [n]. The ellipsis [....] stands for any number of medial positions. Here are some examples of quadrisyllabic compounds, including idiomatic expressions such as (6d):

(6) a. archaeology discipline department

[[*kao - gu*] *xue*]	*xi*	'the department of archaeology'
HMH HMH L?	MLM	BT = oblique-oblique-even-oblique
HMH n H	n	

b. light industry ministry

[*qing* [*gong-ye*]] *bu*		'the ministry of light industry'
H H L? MLM		base tone = even-even-even-oblique
H H H n		

c. red cross association

[*hong* [*shi-zi*]] *hui*		'the Red Cross'
LM L? MLM MLM		base tone = even-even-oblique-oblique
LM H n n		

d. mess seven mess eight

[*gao qi*] [*gao ba*]		'to mess around' (idiom)
LML H LML H		base tone = oblique-even-oblique-even
MLM H n n		

2. Postlexical tone sandhi

2.1. Disyllabic postlexical tone sandhi

We now turn to tone sandhi processes applicable beyond the level of lexical compounds or syntactic words. The clitic group seems to constitute the

maximal domain for postlexical tone sandhi (PTS). A clitic group or a phonological word (p-word) is defined as a single lexical item plus surrounding clitics. A clitic belongs to the closed set of affixes, function words or grammatical particles, generally referred to as *xu-ci* or "empty words", including classifiers/measure words, pronouns, resultative and directional complements. In general tone sandhi (TS) does not extend to genuine syntactic phrases containing more than one lexical head (N,V,A). Phonologically speaking, postlexical tone sandhi is considerably more complex than lexical tone sandhi both in that the diverse surface phonetic outputs of postlexical tone sandhi rules are determined by the register and melody contrasts not only of the input tone but also of those of the neighboring syllables. More importantly, postlexical tone sandhi is complex syntactically in that it is sensitive to constituent structures (right versus left branching) as well as to the specific types of grammatical constructions (number-classifier, verb-pronoun, verb-directional complement etc.).

Let us begin with disyllabic postlexical tone sandhi. The facts are summarized in Table 4.

Table 4. Disyllabic postlexical tone sandhi

<table>
<tr><td colspan="3">PTS Type</td><td colspan="2">PTS-A</td><td colspan="2">PTS-B</td><td colspan="2">PTS-C</td><td colspan="2">PTS-D</td></tr>
<tr><td colspan="3">Syntactic structure</td><td colspan="2">NM, VR</td><td colspan="2">MR</td><td colspan="2">VPr</td><td colspan="2">VD</td></tr>
<tr><td colspan="3">2nd syl
1st syl</td><td>E</td><td>O</td><td>E</td><td>O</td><td>E</td><td>O</td><td>E</td><td>O</td></tr>
<tr><td rowspan="4">E</td><td rowspan="4">1</td><td>H</td><td rowspan="5">$-H</td><td rowspan="2">$-n</td><td rowspan="3">$-H</td><td rowspan="2">$-n</td><td rowspan="5">$-H</td><td rowspan="5">$-H</td><td rowspan="5">$-H</td><td rowspan="5">$-H</td></tr>
<tr><td>2</td><td>LM</td></tr>
<tr><td>7</td><td>H?</td><td rowspan="2">$-M</td><td rowspan="2">$-M</td></tr>
<tr><td>8</td><td>L?</td></tr>
<tr><td rowspan="4">O</td><td rowspan="2">Hr</td><td>5</td><td>M</td><td rowspan="2">HMH-M</td><td rowspan="2">HMH-H</td></tr>
<tr><td>3</td><td>HMH</td><td rowspan="3">$-M</td><td rowspan="3">$-M</td></tr>
<tr><td rowspan="2">Lr</td><td>4</td><td>LML</td><td rowspan="2">LML-n</td><td rowspan="2">LML-H</td></tr>
<tr><td>6</td><td>MLM</td></tr>
</table>

The most striking feature about Table 4 is the structure-sensitivity of postlexical tone sandhi: we need to posit not only a different set of postlexical tone sandhi

rules distinct from lexical tone sandhi, but indeed several sets of postlexical tone sandhi rules for different types of grammatical structures within a clitic group. The first point can be made quite straightforwardly by pairing (a) against (b) in (7) and (8):

(7) a. wine essence

jiu - jing	'alcohol' (lit. essence of wine)
HMH H	base tone = oblique-even
HMH H	by LTS (vacuous)

b. nine catty

jiu jin	'nine catties'
HMH H	base tone = oblique-even
HMH M	by PTS

(8) a. let go

fang - xing	'to let pass through customs'
M LM	base tone = oblique-even
HMH H	by LTS

b. let flat

fang ping	'to lay something flat'
M LM	base tone = oblique-even
M H	by PTS

In (7) and (8), (a) and (b) have the same sequences of base tones. Whereas (7a) and (8a) are lexical compounds, (7b) and (8b) represent clitic groups with the internal structures of number + measure, and verb + resultative complement, respectively. Accordingly, they undergo lexical tone sandhi or postlexical tone sandhi, as the case may be, and yield quite distinct sandhi forms.

As for the second point, namely that different subsets of postlexical tone sandhi rules apply to different grammatical constructions within a clitic group, the case can be made by showing that p-words with identical base tone combinations exhibit different syntactically determined sandhi behaviors. Although exact multiple sets are difficult to find, here is one such example: each of the disyllabic p-words in (9a,b,c) has an /M-M/ sequence (namely two high register oblique tones) as the base tones, and yet each one carries a different sandhi form. (9d) shares the same sandhi form as (9a), because verb + resultative complement (9d) and number + classifier constructions converge in their behavior with respect to disyllabic postlexical tone sandhi. These facts accord with Table 4.

(9) a. four CL

si	*dun*	'four CL (of meals)' (number + measure word)
M	M	base tone = oblique-oblique
M	H	by disyllabic PTS-A

b. time time

ci	*ci*	'every time' (reduplicated measure word)
M	M	base tone = oblique-oblique
HMH	M	by disyllabic PTS-B

c. enter away

jin	*qu*	'go in' (verb + directional complement)
M	M	base tone = oblique-oblique
HMH	H	by disyllabic PTS-D

d. do correct

zuo	*dui*	'do it right' (verb + resultative complement)
M	M	base tone = oblique-oblique
M	H	by disyllabic PTS-A

The base tone sequence /M-M/ happens not to occur with VPr (verb + pronoun) constructions, simply because the three personal pronouns carry either a tone 4 /LML/ (as in *wo* 'I' and *ni* 'you') or tone 2 /LM/ (as in *yi* 'he/she'). Nonetheless, it is not difficult to demonstrate that VPr constructions behave differently from other p-words with respect to postlexical tone sandhi. Contrast (10a) with (10b), and (11a) with (11b,c).

(10) a.

bang	*ni*	'help you'
H	LML	base tone = even-oblique
H	H	by disyllabic PTS-C

b.

san	*tong*	'three barrels'
H	LML	base tone = even-oblique
H	n	by disyllabic PTS-A

(11) a.

yao	*ni*	'bite you'
LML	LML	base tone = oblique-oblique
LML	M	by disyllabic PTS-C

b. barrel barrel

tong	*tong*	'every barrel'
LML	LML	base tone = oblique-oblique
LML	n	by disyllabic PTS-B

(11) c.	*zhuan qi*	'turn up'
	LML LML	base tone = oblique-oblique
	LML H	by disyllabic PTS-D

Needless to say, p-words with different internal grammatical structures do not contrast in all phonological contexts. Thus all p-words with underlying even-even tones show up as $-H, that is, they retain the base tone of the first syllable while changing the second tone to H. However, despite such partial convergences, the systematic asymmetries made evident by Table 4 make it impossible to collapse the four types of postlexical tone sandhi rules.

We have not attempted to formulate the postlexical tone sandhi rules governing disyllabic clitic groups, since the result would have been simply a restatement of correspondences between the base tones and their sandhi forms that can be captured more clearly in a chart like Table 4.

2.2. Trisyllabic postlexical tone sandhi

Chongming postlexical tone sandhi is sensitive not only to the types of grammatical construction within the clitic group, but also to the tree configuration of such constructions. Needless to say, the contrast between right and left branching trees can arise only in constructions of three or more syllables. Evidence indicates that for left-branching p-words, tone sandhi rules apply in a cyclical fashion: first disyllabic lexical tone sandhi or postlexical tone sandhi (depending on the grammatical status of the disyllabic unit in question) applies to the left-most or inner constituent, the output of which in turn determines the phonetic value of the last tone. Specifically, regardless of its base tone, the last syllable takes on a [H] tone if the preceding (sandhi) tone end in [...M], otherwise, a neutral [n] tone appears at the end of trisyllabic clitic groups. This is formulated as (12).

(12) Trisyllabic postlexical tone sandhi-L (Left-Branching)

[[T - T] T]
|
H / ... M ___
n / elsewhere

The cyclic effect of (12) is illustrated in the following examples.

(13) a.	[[*bai-za?*] *yi*]	'boil it'
	L? L? LM	base tone = even-even-even
	L? H	by disyllabic LTS
	L? H n	by trisyllabic PTS-L